Monitoring of the May Canyon Stream Restoration Project

A Summary Presentation by the CIP Monitoring Program
July 2003 LWD Placement Locations
Typical LWD Placement

- All unanchored
- Aggressive in-channel placement
- Most placed in clusters of 2-3 logs
- Some individual “Key” pieces placed
- Primarily targeted homogenous reaches with minimal LWD or hydraulic complexity
- Also in incised reaches upstream of Newcastle Creek
Benefits of LWD

What can we expect?

• Hydraulic complexity
• Habitat complexity
• Scour pools and slow water
• Effect on sediment regime
• Added roughness
• Nutrients for aquatic life
Purpose of this Monitoring Project

• To collect and present data that will inform staff and improve the design of LWD placement projects in the future.

• To document the effects of this and other similar LWD placement projects in urbanizing regions.

• To generate powerful graphics that can be easily and visually interpreted and presented to CPOSA staff, WLRD staff, regulatory staff, clients, council members, other restoration professionals and the general public.

• To demonstrate King County’s overall commitment to monitoring and understanding the effects of our restoration projects.
Goals and Objectives of Monitoring

**Primary Goal**
To clearly document and understand geomorphic processes and aquatic habitat changes in small/medium sized stream channels where Large Woody Debris has been added as a restorative measure.

**Secondary Goal:** To document any changes in fish distribution that may be correlated with the changes in aquatic habitat caused by LWD placement.

**Objectives:** To answer the following questions and others as the data allows:

1. What type and degree of physical changes can we expect?
2. What type and degree of changes in aquatic habitat can we expect?
3. How mobile is LWD relative to pre-project predictions? How far does it typically move downstream? Under what flow conditions and timeframe does it move?
4. Are there particular configurations of LWD that are more effective than others?
5. How does LWD placement affect sediment transport and storage?
6. Is there a shift in distribution of fish in May Canyon towards reaches with placed LWD?
Aerial Photo of project reach showing T1, T2, T3 and C2

- Surveyed 4, 60 meter reaches
- 3 with LWD, one without.
The highest flows between the two survey dates was between a 2.5 and 3 year (annual series) recurrence interval flow.

No Survey Activity in 2005 or 2006
High Resolution Topographic Survey

- High density of shots throughout streambed and banks
- Extensive permanent control points established to assure repeatability.
- Surveyed beyond immediate stream channel to capture surrounding topo.
- LWD position and size surveyed and recorded each year
- Edge of water surveyed during low flow period each year (Aug/Sept)
Additional Data Collected

- Habitat surveys to delineate boundaries between pool and riffle habitat
- Fish abundance (e-shocking) survey (2003 baseline only)
- Substrate composition (2003 baseline only)
Graphics Generated From Surveys

- Plan view, color graphic showing water depth, LWD position/size and the location of pools and riffles in each of the 4 reaches for each survey date.

- Corresponding thalweg profiles with stationing.

- Plan view graphic showing LWD movement between survey dates.

- Plan view, graphic showing the amount and location of scour and deposition throughout each reach between survey dates.
Descriptive Statistics

Only T1 data presented today

1. Total pool & riffle volume for all reaches, each survey yr.
2. Residual pool depths and volumes
3. Total thalweg length.
4. Quantity of scour/deposition (net).
5. Distance LWD moved between survey dates
6. Change in parameters 1-4 between survey dates can be compared between treatment reaches and control reach.
Results to Date

A comparison of 2003 and 2004 survey statistics

Changes in Aquatic Habitat (T1)

<table>
<thead>
<tr>
<th>Habitat Parameter</th>
<th>2003 Channel</th>
<th>2004 Channel</th>
<th>Change Between Survey Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Residual Pool Volume</td>
<td>257 cubic feet</td>
<td>730 cubic feet</td>
<td>+ 473 Cubic Feet Pool V.</td>
</tr>
<tr>
<td>Maximum Residual Pool Depth (Average)</td>
<td>0.87 feet</td>
<td>1.57 feet</td>
<td>+ 8.4 Inches in Max. Pool Depth (average)</td>
</tr>
<tr>
<td>Total Number of Pools</td>
<td>2</td>
<td>5</td>
<td>Three Additional Pools</td>
</tr>
<tr>
<td>Total Number of Riffles</td>
<td>3</td>
<td>5</td>
<td>Two Additional Riffles</td>
</tr>
<tr>
<td>% Pool per Unit Volume</td>
<td>51%</td>
<td>88%</td>
<td>+ 37% in Pool / unit Volume</td>
</tr>
<tr>
<td>% Riffle per Unit Volume</td>
<td>49%</td>
<td>12%</td>
<td>- 37% in Riffle / unit Volume</td>
</tr>
<tr>
<td>Total Active Channel Length</td>
<td>~240 feet</td>
<td>~320 feet</td>
<td>Additional ~70 feet of Active Channel Length (including 40’ side chnl.)</td>
</tr>
</tbody>
</table>
Figure 2: 2003 Water Depths, Habitat Units, Wood Position and Thalweg Profile of Reach T-1
(recorded September, 2003 shortly after project construction)

Longitudinal profile recorded along thalweg marked on plan view above with 10:1 vertical exaggeration.

- **Water Depth Categories**
  - Color
  - Water Depth
    - 0 - 0.25 ft.
    - 0.25 - 0.5 ft.
    - 0.5 - 0.75 ft.
    - 0.75 - 1.0 ft.
    - 1.0 - 1.25 ft.
    - 1.25 - 1.5 ft.
    - 1.5 - 1.75 ft.
    - 1.75 - 2.0 ft.
    - 2.0 - 2.25 ft.
    - 2.25 - 2.5 ft.

- **Legend**
  - Habitat unit divisions
  - Large woody debris as placed in 2003
  - Naturally recruited woody debris
  - Large woody debris as mapped in 2004 after one storm season
2004 Survey Results – T1

Figure 3: 2004 Water Depths, Habitat Units, Wood Position and Thalweg Profile of Reach T-1 (recorded September, 2004 after one storm season)

Longitudinal profile recorded along thalweg marked on plan view above with 10:1 vertical exaggeration.

<table>
<thead>
<tr>
<th>Color</th>
<th>Water Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>orange</td>
<td>0 - 0.25 ft.</td>
</tr>
<tr>
<td>yellow</td>
<td>0.25 - 0.5 ft.</td>
</tr>
<tr>
<td>green</td>
<td>0.5 - 0.75 ft.</td>
</tr>
<tr>
<td>blue</td>
<td>0.75 - 1.0 ft.</td>
</tr>
<tr>
<td>red</td>
<td>1.0 - 1.25 ft.</td>
</tr>
<tr>
<td>violet</td>
<td>1.25 - 1.5 ft.</td>
</tr>
<tr>
<td>pink</td>
<td>1.5 - 1.75 ft.</td>
</tr>
<tr>
<td>brown</td>
<td>1.75 - 2.0 ft.</td>
</tr>
<tr>
<td>gray</td>
<td>2.0 - 2.25 ft.</td>
</tr>
<tr>
<td>gray</td>
<td>2.25 - 2.5 ft.</td>
</tr>
</tbody>
</table>

Habitat unit divisions
Naturally recruited woody debris
Large woody debris as placed in 2003
Large woody debris as mapped in 2004 after one storm season

Blue lines indicate residual pool depth (maximum depth minus outflow depth)
Figure 5: Scour and Deposition Experienced Between 2003 and 2004 Surveys

Legend for Figure 5

- Yellow shaded areas indicate areas of substantial (>0.5 ft.) scour.
- Green shaded areas indicate areas of substantial (>0.5 ft.) deposition.
- The contour lines represent 0.5 ft. changes in elevation.
- The outside boundaries of shaded deposition/scour areas begin at 0.5 ft. of change.
- Blue lines denote the edge of the wetted channel as surveyed in 2003, shortly after project construction.
- Red lines indicate the edge of the wetted channel as surveyed in 2004, one year after project construction.
- Red log shapes indicate the positions of placed woody debris in 2004, one year after project construction.
T1 2004 Lower Jam looking downstream
T1 2003 upper pool looking downstream
T1 2004 upper pool looking downstream
10 LWD pieces scattered throughout
2 existing pools + 1 dammed pool – 6 total units
Long, wide, shallow riffle in lower ½ of site
Straight channel
Several existing pieces of LWD in channel margins
• Most placed LWD in large jam at downstream end
• Recruited LWD also formed jam – Log E
• Substantial racked debris from upstream complex
• Deep, complex pool habitat in lower ½ of site –
• 4 pools, 8 habitat units
• Increase in sinuosity in lower end
• Long, narrow, slightly deeper riffle in upper ½ of site
T2 Scour and Deposition

- Large influx of gravel/sand into upper ½ of site
- LWD appears to have temporarily trapped sediment
- Bars of sediment result in a narrower, deeper channel
- LWD jam caused extensive scour of right bank
- Backwater areas formed downstream of jam in old bed
- In general - much more complex topography and habitat
T2 lower end pre-placement
T2 lower end 2006 – moderate flow
T3 water depth 2003

- 12 LWD pieces scattered throughout
- 2 existing pools + 1 dammed pool – 6 total units
- Long, wide, shallow riffle in upper ½ of site
- Much courser substrate than other reaches w/ cobbles dominant and numerous boulders
• Most LWD moved and jammed at downstream end
• 4 pools – 8 habitat units
• Deeper, more complex pools in lower portion of reach
• Backwater areas along margins with LWD
• Little change in upper portion of reach
• No apparent change in sinuosity or overall channel width
T3 Scour and Deposition

- Extensive scour on right bank due to jam
- Little or no deposition throughout reach – lower bar only
- Very little change in bed elevation in upper ½ of reach
- Slightly steeper reach, upstream of Newcastle sediment source and closer to May Valley.
C2 water depth 2003

- Some existing LWD (small) and boulders
- 3 existing shallow pools, 7 total habitat units
- No LWD added
C2 water depth 2004

- Increase in pool depth around rocks – similar to LWD
- Lost at least 1 piece of small woody debris
- Change in sinuosity apparent, but not directly caused by LWD
- 6 units, 2 pools – possible simplification of habitat
C2 scour and deposition

- Extensive deposition on right bank @ top – cause ???
- Related scour on left bank – possibly due to deposition
- Channel movement has downstream effect on hydraulics and associated sediment transport
  - Inside meander bend bar
  - Scour around boulders
C2 upstream end 2003
C2 upstream end 2004
Log Movement Throughout Entire Project Reach (2003→2005 Observations)

- No logs moved beyond downstream structure
- 172, 182 and 339 CFS events in 2003/2004 water year resulted in substantial movement
- 64 of the 89 (72%) tracked logs moved < 30 feet
- Of the 25 logs that moved > 30 feet downstream
  - 13 moved only 30 to 100 feet downstream,
  - 10 moved 100 to 200 feet downstream
  - 2 moved more than 300 feet downstream.
Conclusions to Date

• Deposition and scour around LWD increased physical complexity of the streambed in treatment reaches

• Corresponding increase in hydraulic complexity and habitat complexity (e.g. +2.33 pools, + 3 units, large increase in pool volume and quality)

• Substantial change also observed in control reach, but the end result was simplification of the channel & habitat

• Very large pieces of LWD were mobile even under moderate flow conditions, but only during the 1st yr. floods and they did not move far.

• This methodology is an effective means of communicating the effects of these projects to interested parties.
More To Come!!!

- We have only seen results of several moderate flood events.
- Survey will be repeated after a very large event and after more time.
  - Is LWD still stable under highest flows and after some decay?
  - Are habitat improvements persistent?

(Daily Max flows 1991 thru 2006 @ Coal Creek Parkway)
Acknowledgements

• May Canyon Project Team
  • Kathryn Neal, John Bethel, Kerry Bauman, Ingrid Haynes, Paul Adler, Abel Eckhardt and WCC crews

• May Canyon Monitoring Team
  • John Bethel, Kathryn Neal, Laird ORollins, Laura Hartema, Meredith Radella, Lucy Traxinger, Beth Carpenter, Larry Goulet, Hans Berge

• ESM Civil Engineers
  • Stephen Phillips and survey crews

• Management
  • For supporting this and other monitoring projects
## May Canyon LWD life to Date Expenditures compared with Original 2003 estimate

Last updated 1/18/2005

### Phase 1 - Baseline Survey (2003)

<table>
<thead>
<tr>
<th>Actual Expenditure</th>
<th>Original 2003 estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$31,500</td>
<td>$64,000 Original estimate for detailed topo, habitat and fish abundance surveys with no substantial analysis this year.</td>
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<tr>
<td>$2,500</td>
<td></td>
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<tr>
<td>$13,000</td>
<td></td>
</tr>
<tr>
<td>$7,500</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$54,500</strong></td>
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</table>

### Phase 2 - 2nd survey & analysis/presentation of 1st and 2nd survey results (2004, 2005 and 1st qtr 2006)

<table>
<thead>
<tr>
<th>Actual Expenditure</th>
<th>Original 2003 estimate</th>
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<tbody>
<tr>
<td>$10,900</td>
<td>$61,000 Original estimate for detailed topo, habitat and fish abundance surveys and interim analysis and presentation of results showing changes between survey dates</td>
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<tr>
<td>$5,500</td>
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<tr>
<td>$1,500</td>
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<tr>
<td>$3,000</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$20,900</strong></td>
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<td>$13,400</td>
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<tr>
<td>$1,900</td>
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<td>$15,600</td>
<td></td>
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<tr>
<td>$1,000</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$31,900</strong></td>
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<tr>
<td>$6,200</td>
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<tr>
<td>$8,700</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$14,900</strong></td>
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### TOTAL Life to Date

<table>
<thead>
<tr>
<th>Actual Expenditure</th>
<th>Original 2003 estimate</th>
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<tbody>
<tr>
<td>$122,200</td>
<td>$125,000 original estimate for first two phases.</td>
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</table>

#### Summary stats.

- **CPOSA labor**: $60,200
- **ESM survey, compilation, analysis and graphics**: $62,000
  - **ESM survey alone**: $42,400
  - **ESM data compilation and graphics**: $19,600

### Phase 3 = 3rd survey after very large event (>10 yr)

PHASE 3 not initiated yet - possibility in 2006 after large storm on Jan 11th

<table>
<thead>
<tr>
<th>Actual Expenditure</th>
<th>Original 2003 estimate</th>
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<tbody>
<tr>
<td>$70,000</td>
<td>original estimate for 3rd survey, analysis of 3rd survey and final analysis and presentation of results of all three surveys.</td>
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